# Atoms Unite! Let’s Make a Bond!

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Excellent extension of “The Periodic Table: What’s the Trend?” GK-12 Lesson

## Teacher Material

**California State Standards**

Chemistry (Chemical Bonds)

* 2a: Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.
* 2b: Students know chemical bond between atoms in molecules such as H2, CH4, NH3, H2CCH2, N2, Cl2 and many large biological molecules are covalent.
* 2e: Students know how to draw Lewis dot structures
* 2g\*: Students know how electronegativity and ionization energy relate to bond formation (Only when extended portion is used)

**Synopsis** The purpose of this inquiry-based lesson is to guide students to build their own concepts about bonding. Students will explore the concepts of ionic and covalent bonds by building Lewis Dot structures and combining several structures to form compounds. Students should be able to predict what type of bonding connects two atoms of small common molecules.

**Background** Students need to have knowledge of subatomic particles (specifically electrons) and how those electrons are arranged around the nucleus. Knowledge of the octet rule is helpful, but the first part of this lesson can be used to teach the octet rule if necessary, although It would be beneficial

**Objectives**

1. Students will know how to draw Lewis Dot structures
2. Students will know the atomic structure of a noble gas
3. Students will know how to combine Lewis Dot structures to form reasonable structures
4. Students will be able to recognize the type of bonding that is present (ionic or covalent)
5. Students will be able to predict the type of bonding in common small molecules

# Suggested Timeline

One Day (50 min period).

**Materials (for each group, cost)**

* Index Cards (~25 cards per group of 4)
* Label Dots – Small (size appropriate for electrons)
* Markers

**Teacher’s Tips**

As with most inquiry lessons, a lot of guidance must come from the teacher. Members of each group should be able to help each other.

**Classroom Activities**

1. Warm Up Activity (5 min), Review electronic structure, using the periodic table to know how many valence electrons an element has and the octet rule.
2. Review how to make observations and what constitutes a good observation.
3. Arrange students in groups of 4
4. Hand out index cards, electrons (label dots) and student handout.
5. Students should first build the Lewis Dot structures of 2 Nobel Gasses (Ne and Ar). (10 min) (note this can be used to teach the octet rule if not discussed already)
   1. Students will need direction here!
   2. Instruct students to write the Atomic Symbol of the element in the center of the index card
   3. Have students determine the number of valence electrons
   4. Have students arrange the atomic symbol in pairs
   5. Ask students to comment on the structure they see in front of them. (questions on handout will lead to the word “nobility” to describe these structures).
   6. Review with students that this is a Lewis Dot Structure (what they just built)
6. Ionic Bonding: Building the bonds (10-15 min)
   1. Have students will work in their groups to build the Lewis Dot structures for Lithium, Beryllium, Sodium, Magnesium, Oxygen, Fluorine, Sulfur, and Chlorine.
   2. Students are instructed (on their hand out) to build as many combinations as possible that agree with the octet rule.
   3. Have students report out by writing their structures on the board.
   4. Students are asked to make observations about the bonds that are formed.
7. Covalent Bonding: Building the bonds (10 min)
   1. Build Lewis Dot Structures for C and N and several (10) H’s.
   2. Students are instructed to build reasonable structures that adhere to the octet rule.
   3. Some instruction may be necessary for students to know they can have more than one hydrogen atom in a structure and students may need a reminder that the outer shell of hydrogen can only have two electrons in it.
   4. Students report out by drawing their structures on the board
   5. Ask students how hydrogen could be bonded to itself.
   6. Have students build two Chlorine atoms.
   7. How can Chlorine react with itself
   8. Students report out by drawing the structures on the board.
   9. Have students make observations about the bonds
8. Comparing the bonds (5 min)
   1. Ask students to compare the different bonding in NaCl and Cl2
   2. Extended Portion: (For higher excelling students) After a few minutes of brainstorming, ask the students to find the electronegativity and ionization energy data for each element. Have the students write the values on the index card. Then students can make observations based on the new data.
   3. One member of each group reports out to the class
9. Review Definitions of Ionic and Covalent Bonding, Fill out graphic organizer.

**Sample Test Questions**

List potential test questions, if applicable.

**Resource Materials**

(STUDENT HANDOUT BEGINS)

# Atoms Unite! Let’s Make a Bond!

**Introduction** Today you will learn about chemical bonding. Use your knowledge of the atom to build compounds and describe the bonding.

**Materials**

* Blank Index cards
* Label dots – small red
* Markers

**Methods**

In groups of 4 you will build Lewis Dot structures for several elements. By combing those elements into compounds you will explore bonding.

**Instructions and Discussion Questions**

**Part I - Instructions:** Using a marker, write the Atomic Symbol of neon on the center of an index card. Determine the number of valence electrons (electrons in the outer shell of Ne) and put that number of label dots around the atomic symbol on the index card. Start by putting one electron on each side of the symbol (top, right, bottom, left). If you have more electrons to add, pair the electrons as needed to add all the valence electrons. You’ve just made a Lewis Dot structure!!! Now make one for argon.

1. What group/family of the periodic table are neon and argon in?
2. Write down observations about the Lewis Dot structures you just made.
3. Why do you think neon and argon are called **noble** gases? What does noble mean, and what about their structures makes them noble?
4. What is an octet? (Hint: octopus, octagon)
5. The Octet Rule requires that atoms in bonded species tend to have noble-gas structures. Define octet rule in your own words.

**Part II -** Build Lewis Dot structures for lithium, beryllium, sodium, magnesium, oxygen, fluorine, sulfur and chlorine.

1. How many compounds (combinations of 2 different atoms) can you make that satisfy the octet rule? List the compounds here.
2. What do you notice about the bonding of your compounds? Write your observations here.

**Part III:** Build Lewis Dot structures for hydrogen, carbon, and nitrogen. You may build as many hydrogen atoms as you need to answer the following questions.

1. How many compounds (combinations of 2 different atoms) can you make? List the compounds here.
2. What do you notice about the bonding of these compounds? Write your observations here.

**Part IV:** Build two chlorine Lewis Dot structures. How could these two chlorine atoms bond? Write your observations here.

**Part V:** Compare the Lewis Dot structures for sodium chloride (NaCl) and dichlorine gas (Cl2).

1. What do you notice about the two different bonds? Write your observations here.
2. Which compound do you think shares electrons?
3. Which element do you think could exchange electrons to form a bond?

**Part VI:** Fill out the following chart

|  |  |  |
| --- | --- | --- |
|  | **Definition** | Picture |
| Ionic Bonding |  |  |
| Covalent Bonding |  |  |

(STUDENT HANDOUT ENDS)